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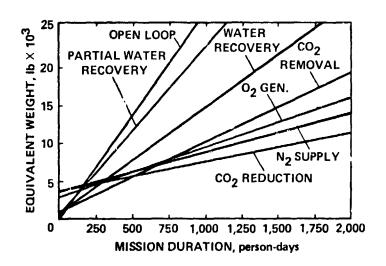
QUATTRONE FIGURE 1 SPACE SHUTTLE AIR REVITALIZATION SYSTEM CARBON DIOXIDE CONCENTRATOR SUBSYSTEM HO! SPACE SHUTTLE AIR REVITALIZATION SYSTEM WATER HANDLING STORAGE/DUMP AIR + CO2 CABIN HUMIDITY CONTAMINANT (ACTIVATED CHARCOAL) SUPPLY (LOX) SUBSYSTEM SUBSYSTEM AIR + H20 H₂0 CONTROL CONTROL OXYGEN 0 AIR + CO2 + H₂O NITROGEN SUPPLY (HP STORAGE) **CREW SPACE** N2

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FIGURE 2

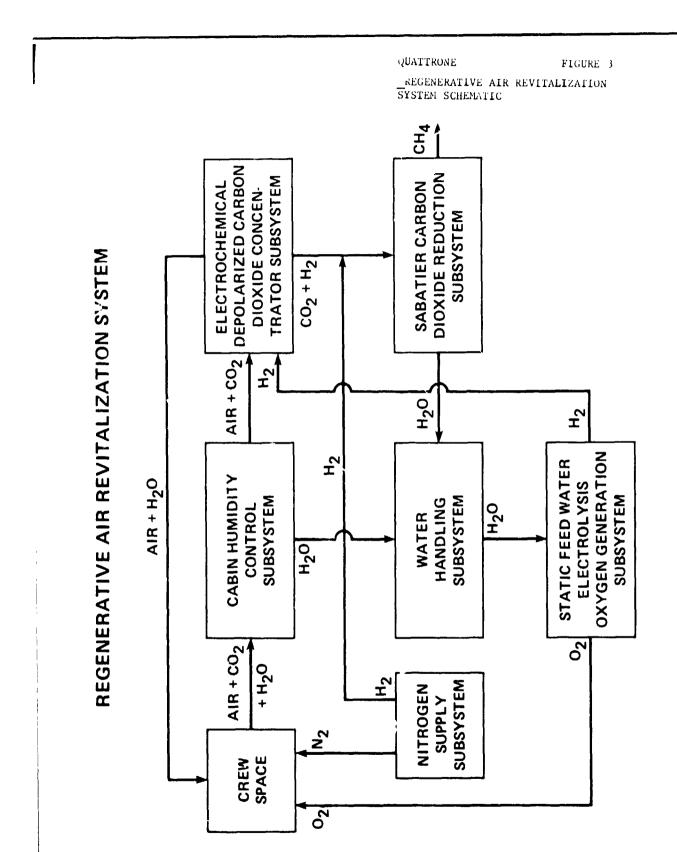
REGENERATIVE VS OPEN LOOP ECLSS TRADE-OFFZ

REGENERATIVE vs OPEN LOOP EC/LSS



SEQUENTIAL STEPS IN LOOP CLOSURE

DEFINITION	DESCRIPTION
PARTIAL WATER RECOVERY	HUMIDITY CONDENSATE COLLECTION
WATER RECOVERY	POTABLE WATER RECOVERY AND TREATMENT FROM URINE AND WASH WATER
CO ₂ REMOVAL (NONEXPENDABLE)	REPLACEMENT OF EXPENDABLE LICH WITH REGENERATIVE CO ₂ COLLECTION TECHNIQUE
O ₂ GENERATION	GENERATION OF O_2 THROUGH WATER ELECTROLYSIS USING RECLAIMED WATER
N ₂ GENERATION	GENERATION OF N_2 THROUGH DISSOCIATION OF HYDRAZINE
CO2 REDUCTION	DECREASE IN EXPENDABLE WATER BY RECOVERING PRODUCT FROM CO ₂ REDUCTION (SABATIER) PROCESS



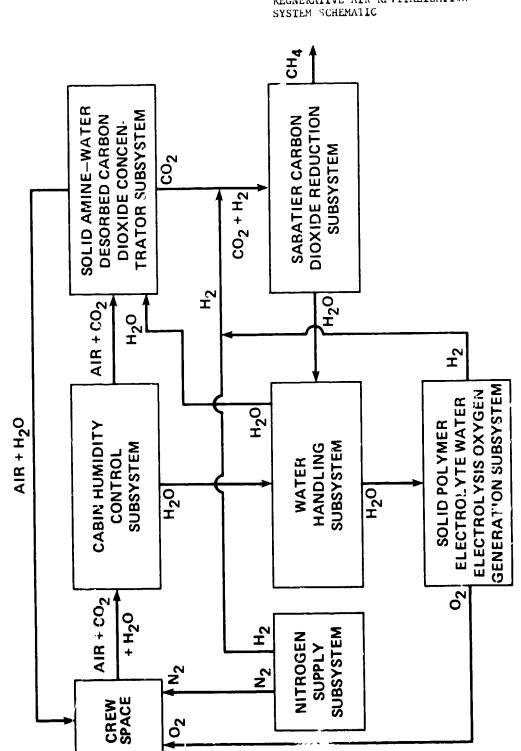
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FIGURE 4

REGNERATIVE AIR REVITALIZATION SYSTEM SCHEMATIC



REGENERATIVE AIR REVITALIZATION SYSTEM

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FIGURE 5

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REGENERATIVE AIR VITALIZATION SYSTEM SCHEMATIC, NUMBER 2.

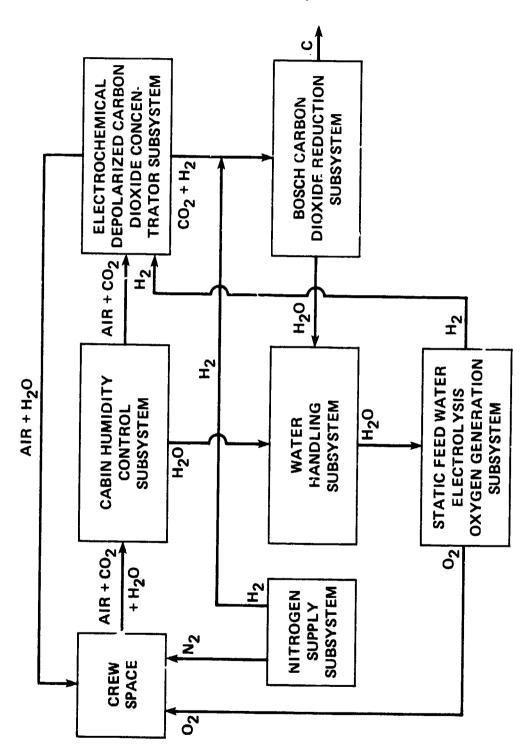
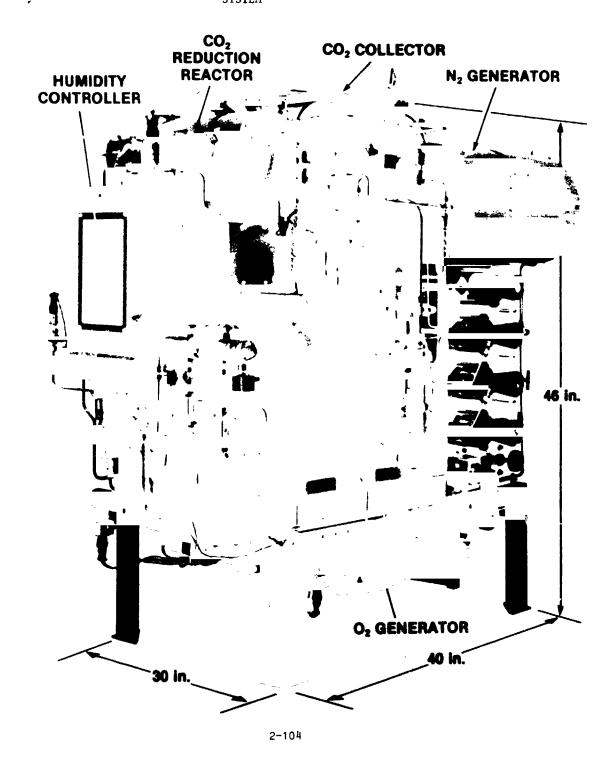
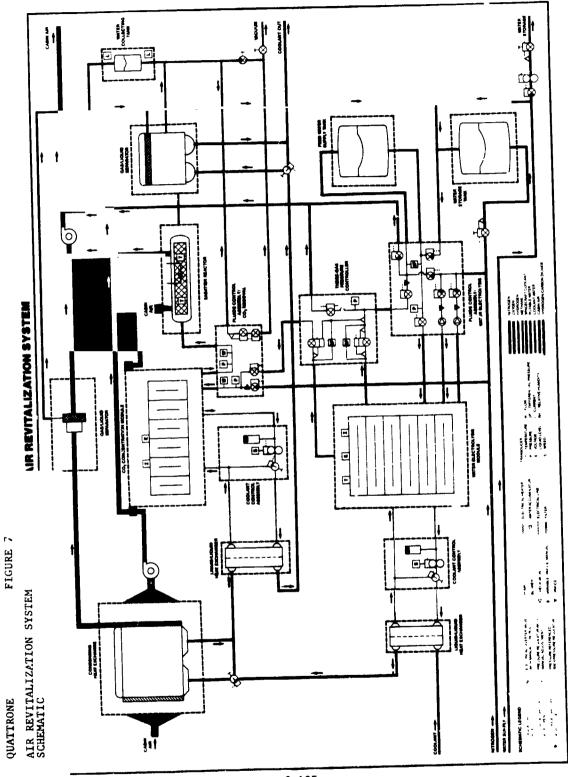


FIGURE 6

EXPERIMENTAL AIR REVITALIZATION SYSTEM



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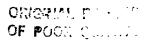
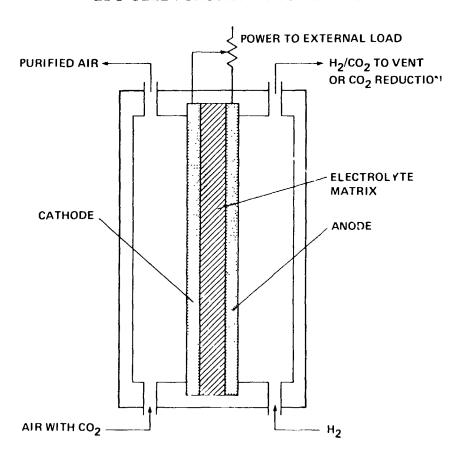


FIGURE 8

ELECTROCHEMICAL DEPOLARIZED CARBON DIOXIDE CONCENTRATOR CELL SCHEMATIC

EDC CELL FUNCTIONAL SCHEMATIC



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FIGURE 9

ELECTROCHEMICAL DEPOLARIZED CARBON DIOXIDE CONCENTRATOR SUBSYSTEM

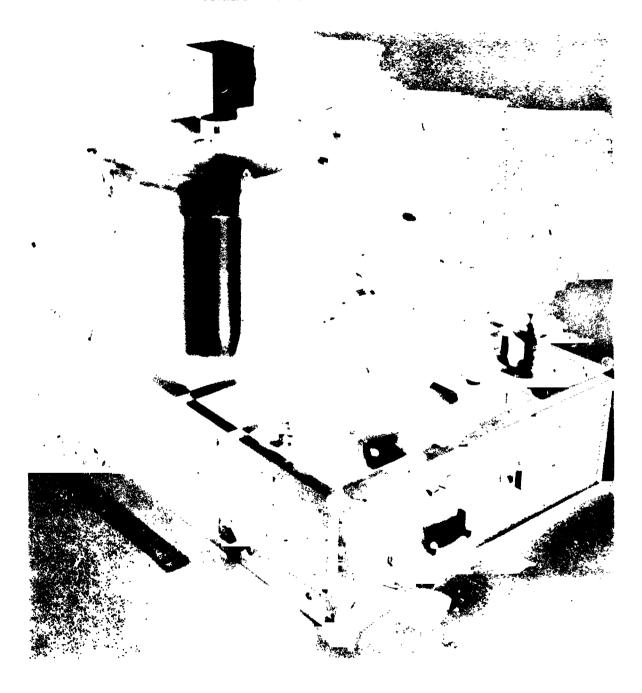


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FIGURE 10

SOILD AMINE-WATER DESORBED CARBON DIOXIDE CONCENTRATOR SUBSYSTEM



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COOLING AIR MAINTAINABLE CARTRIDGE HEATER FIGURE 11 SABATIER CARBON DIOXIDE REDUCTION SUBSYSTEM THERMAL EXPANSION JOINT COOLING AIR QUATTRONE CH4 + H2O (VAPOR) C · + H2 NALET

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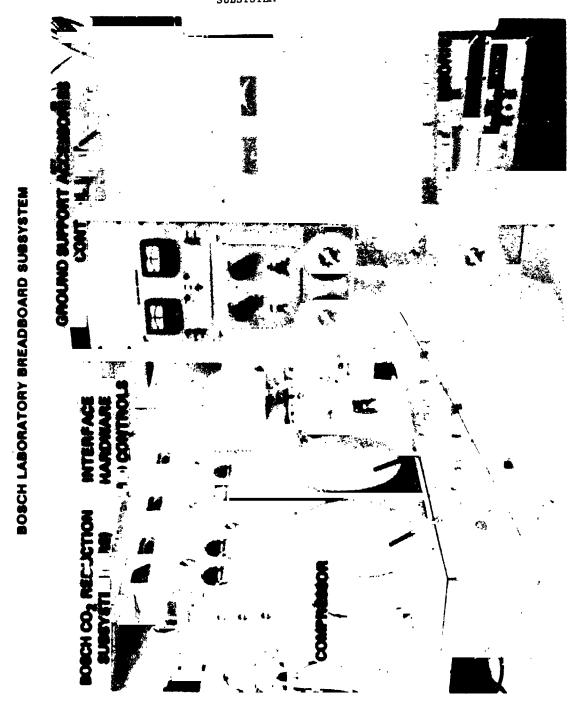
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FIGURE 12

BOSCH CARBON DIOXIDE REDUCTION SUBSYSTEM



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A – BOSCH B – SABATIER, WITHOUT NSS FOR MAKEUP H₂ C – SABATIER, WITH NSS FOR MAKEUP H₂

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QUATTRONE FIGURE 13 SABATIER/BOSCH TRADE-OFF COMPARISON

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COMPARISON OF CO₂ REDUCTION SUBSYSTEM CONCEPTS

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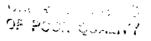
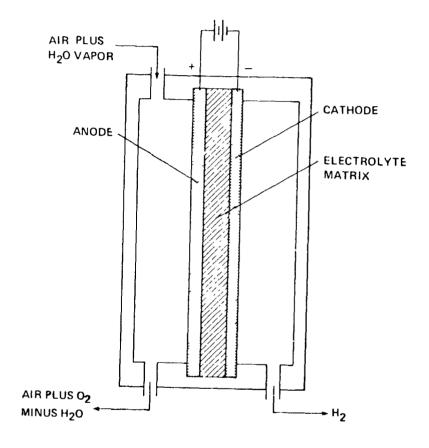


FIGURE 14

WATER VAPOR ELECTROLYSIS CELL SCHEMATIC

WVE CELL FUNCTIONAL SCHEMATIC



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FIGURE 15

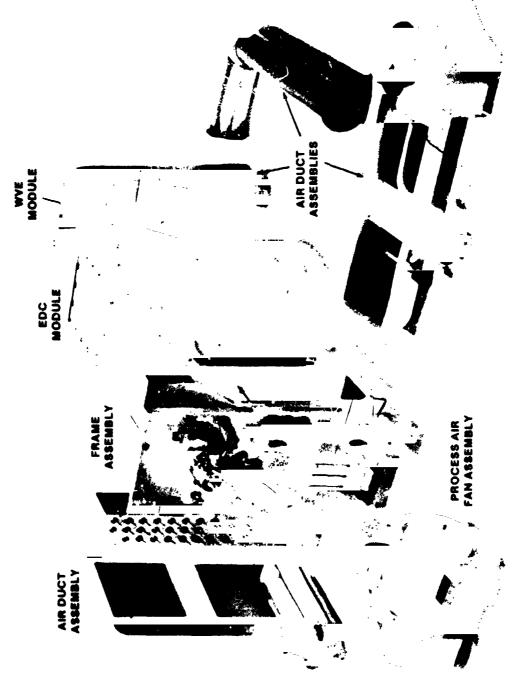
WATER VAPOR ELECTROLYSIS SUBSYSTEM



IARS RLSE DEVELOPMENT HARDWARE

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INDEPENDENT AIR LEVITALIZATION SYSTEM



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FIGURE 17

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STATIC FEED $[i_\ell]_{\ell,\ell}$ = ELECTROLYSIS CELL SCHEMATIC

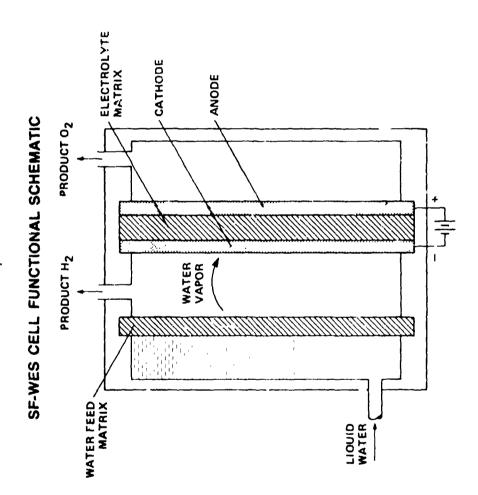
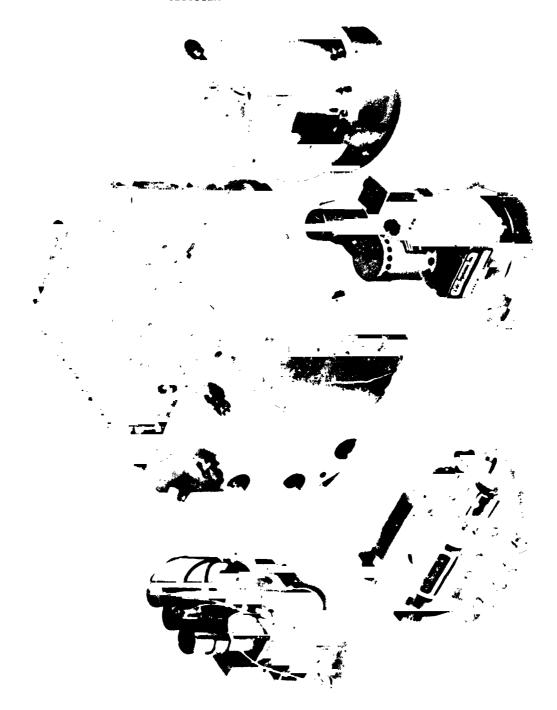


FIGURE 18

STATIC FEED WATER ELECTROLYSIS SUBSYSTEM



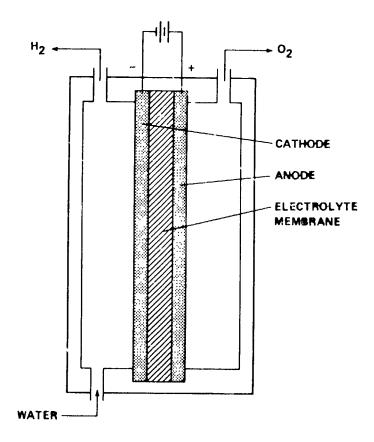
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FIGURE 19

SOLID POLYMER ELECTROLYTE WATER ELECTROLYSIS CELL SCHEMATIC

SPE-WES CELL FUNCTIONAL SCHEMATIC





RLSE SPE-WES MODULE

SOLID POLYMER ELECTROLYTE WATER ELECTROLYSIS MODULE QUATTRONE

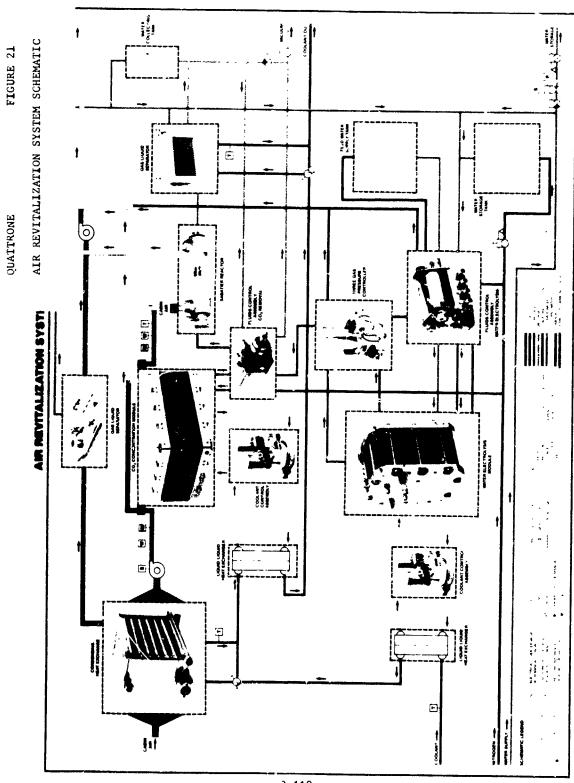
PRESSURE HOUSING

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CELL STACK

FIGURE 20

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FIGURE 22 NITROGEN GENERATION REACTIONS

NITROGEN GENERATION

(1000 °K; 200 PSIA)

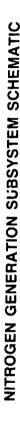
1/3 N ₂ + 4/3 NH ₃	2/3 N ₂ + 2H ₂	N ₂ + 2H ₂ (OVERAL
(PT)	(Ir, Rh, Fe/ALUMINA)	
(1) N ₂ H ₄	(2) 4/3 NH ₃	(3) N ₂ H ₄

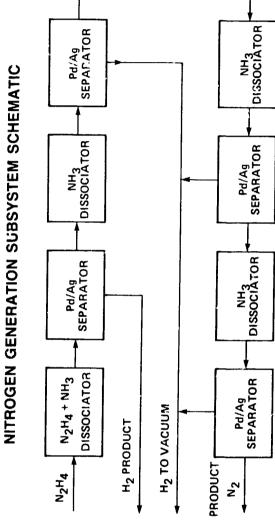
FIGURE 23 NITROGEN SUPPLY SUBSYSTEM STAGING SCHEMATIC QUATTRONE

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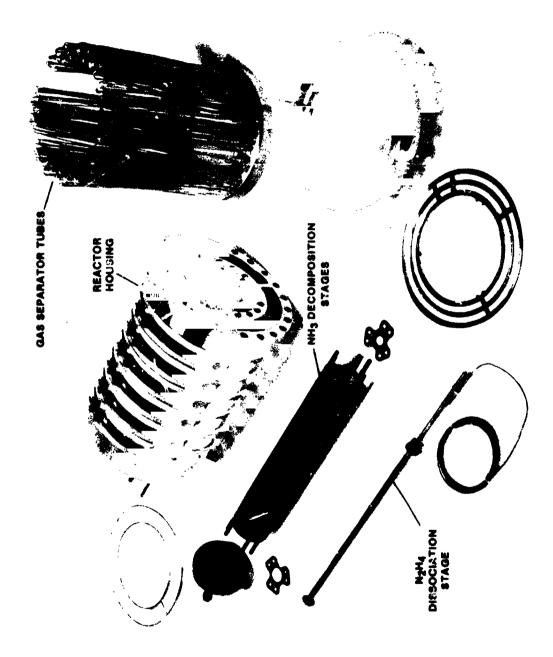
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FIGURE 24

NITROGEN SUPPLY SUBSYSTEM MODULE

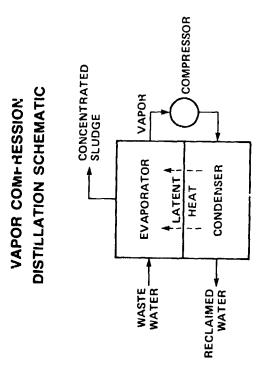


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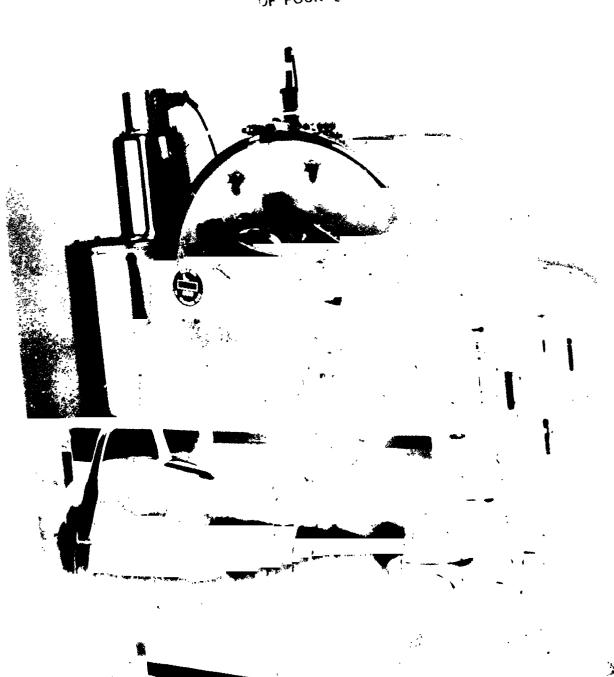
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FIGURE 25

VAPOR COMPRESSION DISTILLATION SUBSYSTEM SCHEMATIC



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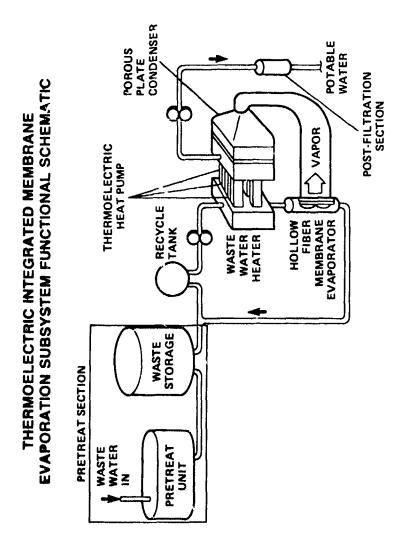
QUATTRONE FIGURE 26
VAPOR COMPRESSION DISTILLATION SUBSYSTEM HARDWARE

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THERMOELECTRIC INTEGRATED MEMBRANE EVAPORATION SUBSYSTEM SCHEMATIC



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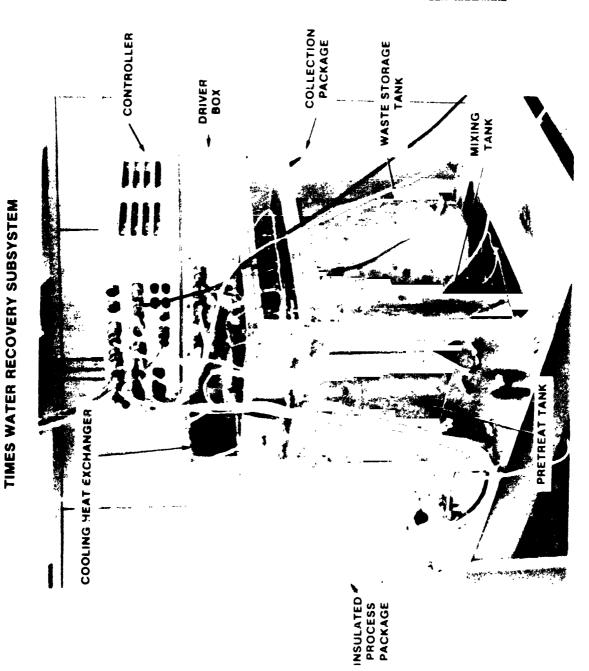
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FIGURE 28

THERMOELECTRIC INTEGRATED MEMBRANE EVAPORATION SUBSYSTEM HARDWARE



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FIGURE 29

CATALYTIC DISTILLATION WATER RECLAMATION SUBSYSTEM SCHEMATIC

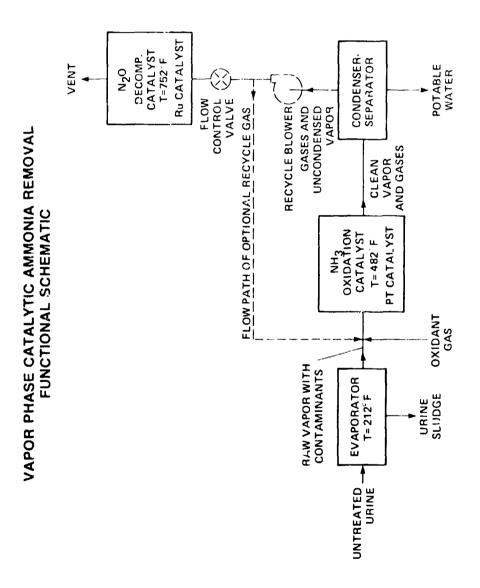
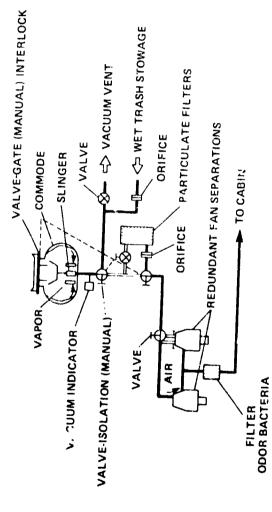


FIGURE 30

SPACE SHUTTLE SOLID WASTE MANAGEMENT SYSTEM

SOLID WASTE MANAGEMENT SYSTEM/SPACE SHUTTLE



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